Import Prices, Income, and Inequality*

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ABSTRACT: We compare three theoretical explanations for the positive empirical relationship between importer income per capita and traded goods prices. A first explanation is that consumers with higher incomes demand higher quality goods with higher prices. A second explanation is that wealthier people exhibit an increased willingness to pay for necessary goods as more goods enter the consumption set in a hierarchic demand system, and can thus be charged higher markups. A third explanation is that consumers with higher incomes are more finicky regarding their preferred variety in an ideal variety framework and can thus be charged higher markups. We discriminate between these three theories by focusing on the effect of income inequality on trade prices. Based on a large dataset with bilateral HS6 level data on 1260 final goods categories from more than 100 countries between 2000 and 2004, we find a highly significant negative effect of income inequality on unit values. This contradicts both the demand for quality and finickyness theories, while providing support for the increased willingness to pay theory linked to hierarchic demand. These findings on income inequality do not falsify the quality expansion model and the ideal variety model per se. However, the results do argue for place of importance of hierarchic demand.

Keywords: Unit Values, Importer Characteristics, Quality Expansion, Hierarchic Demand, Ideal Variety

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1 Introduction

The prices of traded goods vary systematically with the characteristics of exporting countries, like the income and factor abundance of exporting countries (Schott 2004). Prices also vary with importer characteristics, like income per capita and market size (Hummels and Lugovskyy 2009, and Simonovska 2010). In this paper we focus on the relationship between import prices, income per capita, and inequality. We compare and test three different theoretical frameworks to explain the documented rise in prices associated with higher importer income per capita. We discriminate between them by examining the effect of income inequality on unit values of trade. Along a first channel, consumers with higher incomes demand greater quality goods in a setup with utility expanding both in quantity and quality. Along a second channel a higher income reduces price elasticity as goods become more necessary in the consumption bundle in a hierarchic demand system proposed by Jackson (1982). The third channel features consumer preference for ideal varieties, building on the model of Lancaster (1979).

Our contributions follow from identifying analytical differences between the different theoretical explanations that allow us to collectively confront their predictions with the data.[1] Based on a large dataset with bilateral HS6 level data on 1260 final goods categories from more than 100 countries, we find that unit values rise significantly with importer income per capita, confirming the findings in Hsieh and Klenow (2007), Hummels and Lugovskyy (2009), Simonovska (2010) and Alessandria and Kaboski (2011). Indeed this is consistent with all three theoretical explanations stressed in the literature. However, we also find that trade prices decline with income inequality (measured by the Atkinson index). These results contradict the quality and ideal variety models and provide support for the price elasticity mechanism linked to hierarchic demand. This finding on income inequality does not falsify the quality expansion model and the

[1] Various authors have addressed the effect of income inequality in importing countries on the patterns of trade. Francois and Kaplan (1996) and Dalgin, Mitra and Trindade (2008) examine the effect of income inequality on the type of goods imported finding that a higher income inequality leads to more demand for differentiated goods and for luxury goods, respectively. Fajgelbaum, Grossman and Helpman (2009) also study the effect of income inequality on the patterns of trade in a model featuring demand for quality. These papers do not explore the effect of income inequality on unit values of trade. Choi, Hummels and Xiang (2009) examine empirically the link between income distribution of the importer country and the price distribution of import prices, applying the theoretical model of Flam and Helpman (1987). Our approach is distinct from these because we focus on the effect of average income and inequality on average unit values. Lipsey and Swedenborg (1999) and Lipsey and Swedenborg (2007) examine national prices (including non tradables) and give a supply side explanation for a positive effect of income per capita and wage compression on national prices focusing on the services/non tradables component of prices. Our paper is different as we focus on demand side explanations of price differences of tradables.

ideal variety model per se. In our view, it is likely that all three demand-side mechanisms provide part of the explanation for the positive effect of income per capita on trade prices. However, the results do argue for place of importance for the price elasticity channel linked to hierarchic demand.

These results, which link variations in trade prices to differences in markups, have important implications. First, the fact that observed price differences are at least partially driven by variations in markups implies market power and thus possibly welfare distortions. The welfare and policy implications of international price discrimination are unclear, because possible welfare distortions have to be traded off against potentially larger resources to develop more varieties. Second, the importance of the markup channel and pricing to the market implies that regulation of parallel imports has welfare impacts.[2] If differential demand for quality would be the only driver of price differences, there would be no incentive for parallel imports, as it does not pay off to resell a product with an optimal quality level in another market, where consumers demand a different quality level. With differences in optimal markups, there is an incentive to resell identical products when they are sold both in a market with high markups and at a lower price in a market with lower markups.[3]

This paper fits in the literature on pricing to the market, with firms charging different prices for identical goods across different markets due to differences in market conditions (Goldberg and Knetter, 1997). It is also related to the literature using large datasets on unit values of trade to analyze the relation of unit values with importer and exporter country characteristics (Schott 2004, Baldwin and Harrigan 2011, Pham 2008). The competing theoretical explanations found in the literature highlight different mechanisms linking trade prices to the income levels of importers (Fajgelbaum, Grossman and Helpman 2009, Simonovska 2010, Hummels and Lugovskyy 2009). To represent the first explanation, with demand for quality rising in income, we examine a utility function that expands both in quality and quantity consumed. Production is constant returns to scale and the market structure involves perfect competition. Higher incomes then raise demand for quality. With marginal costs rising in quality, this increases prices. To represent the second explanation with hierarchic demand, we work with a variant of Stone-Geary preferences

[2] See Goldberg and Knetter (1997) for a review of the recent literature exploring pricing to the market.
[3] We leave a welfare comparison of the outcomes with and without parallel imports for future work.

with negative instead of positive vertical intercepts, introduced by Jackson (1982). This type of preferences has been recently used by Simonovska (2010) to examine cross-country prices in a general equilibrium model with heterogeneous firms. In our model agents expand their consumption set as they become richer. As the set of consumed goods becomes larger, the price sensitivity on goods lower in the hierarchy shrinks. The intuition is that goods lower in the hierarchy become more necessary and therefore their price elasticity declines. In a setting with market power this leads to higher prices. We model market power with small group monopolistic competition between firms within each sector. Hence, within each set of consumed goods (sector), there are various differentiated goods. Finally, to represent demand based on ideal varieties, wherein consumers become less price sensitive (and firms can thus charge higher markups) with higher incomes, we use an adapted version of the ideal variety framework of Lancaster (1979), generalized by Hummels and Lugovskyy (2009) to explore cross-country price variation. In all three cases, in order to focus on the demand side explanations we analytically sterilize the influence of supply side factors.

The effect of inequality operates in all three mechanisms through both the direct effect on the demand of different income groups, as well as an indirect effect. The indirect effect involves a shift in the relative importances or weights of low-income and high-income consumers in overall demand (the weights effect). From the weights effect, higher inequality leads to higher prices in all three mechanisms. In particular, there will be more weight on the high quality consuming high income consumers in the quality model, and more weight on the low price elasticity high income consumers in the varying markup model. As such, what matters is the relative impact of the weights or consumer composition effect vis-à-vis the direct effect on consumer demand. The direct effects on low and high quality cancel out in the quality model, implying that larger inequality leads to higher prices by the weights effect. In the ideal variety model, the direct effect is dominated by the weights effect, implying as well that prices go up. In the hierarchic demand model, high income consumers extend their budget set besides consuming more in each sector. As a result, the direct effect dominates the weights effect and henceforth prices go down.

We have organized the paper as follows. In Section 2 we outline the three theoretical channels linking inequality to prices, with much derivation relegated to Appendix B and an appendix available upon request. In Section 3 we discuss data and empirical methods. Section 4 contains

our empirical results and in Section 5 we conclude.

2 Theory

2.1 Preliminaries

Three channels through which the income per capita of an importer country affects trade unit values are explored in this section. Empirically, we focus on the effect of variation of these variables over time on within sector variation in unit values. Hence, we concentrate on within sector variation in unit values.

Throughout, we assume that all agents have identical preferences and labor is the only production factor. Each agent has an amount of labor units i at its disposal. Income inequality is modeled such that agents differ in the amount of labor they have with labor still homogeneous. There are G types (groups) of agents, indexed by subscript g, differing in the amount of labor i_g at their disposal, hence income of agent g is equal to i_g.[4] The number of workers of different types is equal and normalized at 1.[5]

There are 2 countries, indexed by subscripts k and l. There are no trade costs, but we exclude parallel imports, for example because regulation forbids parallel imports for differentiated goods.[6] Countries only differ in income and income inequality, i.e. in the average amount of labor units or in the distribution of the labor units across different groups. Both countries produce in all sectors and charge different prices in the 2 different markets, either because of differences in demand for quality or because of differences in their price sensitivity. As countries only differ in

[4] With two income groups, we can interpret high and low income as skilled and unskilled labor with perfect substitutability between the two types of labor. In other words, with labor scaled in constant units on an output basis, higher endowments of labor represent higher productivity or skill levels.

[5] All derivations of this section not shown explicitly here are described in Appendix B and an appendix available upon request.

[6] Parallel imports are largely precluded under both EU and US law, with policies of "regional exhaustion" or "national exhaustion" meaning that firms can choose how their products and trademarks are distributed (Maskus and Chen (2004)). The structure of the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) reinforces this approach as well. The notable exception is pharmaceuticals, where governments have explored parallel imports as a mechanism to discipline drugs pricing, and where a strategic battle between government and industry is underway (Bennato and Valletti (2011), Grossman and Lai (2008)). However, given current legal protections, ability to engage in differential pricing remains the regulated norm. For example, in 2011 Apple sold the entry level macbook Air for $999 in the United States and $1,350 in the EU. The empirical literature on cross-country price discrimination provides evidence of sustained pricing to market practices (see Goldberg and Verboven (2001), Goldberg and Verboven (2005), Ghosh and Wolf (1994), Haskel and Wolf (2001), Bugamelli and Roberto (2008) and Simonovska (2010).

the amount of labor units, wages are equal in both countries and can be normalized at 1.[7]

2.2 Demand for Quality

2.2.1 Basics

The first channel put forward is an increased demand for quality as agents become richer. As higher quality goods are more expensive to produce, higher income levels lead to higher priced goods. We start with a specification where all agents have the same income i. To focus on differential demand for quality within sectors as a function of income and market size, we work with Cobb-Douglas preferences across sectors j and within each sector j. Preferences depend both on quantity q_j and quality α_j as they enter into utility U:

$$U = \prod_{j=1}^{m} u_j^{\beta_j};\ 0 < \beta_j < 1 \text{ for all } j,\ \sum_{j=1}^{m} \beta_j = 1 \tag{1}$$
$$u_j = \left(\alpha_j^{\frac{\rho-1}{\rho}} + q_j^{\frac{\rho-1}{\rho}} \right)^{\frac{\rho}{\rho-1}} \text{ for all } j$$

In equation (1) u_j is the sectoral utility, β_j are the Cobb-Douglas parameters and ρ is the substitution elasticity between quality and quantity. The cost function of a firm in sector j is equal to:

$$c_j\left(q_j, \alpha_j\right) = \alpha_j^{\gamma} a_j q_j;\ 0 < \gamma < 1$$

Hence, marginal costs rise with quality α_j, although less than proportional. a_j is a sector specific marginal cost shifter. Given the fact that with perfect competition price is equal to marginal cost, we can find the equilibrium amounts of quality α_j and quantity q_j by maximizing utility subject to the following budget constraint with the marginal costs substituted for prices:

$$\sum_{j=1}^{m} \alpha_j^{\gamma} a_j q_j = i \tag{2}$$

[7] We could capture wage differences across countries by introducing a country-specific productivity parameter on labor. In all three models, the level of income then would lead to the same prediction related to changes in the level of prices for a given level of inequality. However, as we are interested in the opposite instance where the models diverge – the impact of inequality on prices given mean income, we do not focus explicitly on these mechanisms here.

Maximizing utility in equation (1) s.t. (2) generates the following equilibrium outcomes for individual demand q_{lj}, quality α_{lj} and price p_{lj} in country l.

$$q_{lj} = \gamma^{\frac{\rho}{1-\rho}\frac{\gamma}{1+\gamma}} \left(\frac{\beta_j i_l}{a_j}\right)^{\frac{1}{1+\gamma}} \tag{3}$$

$$\alpha_{lj} = \gamma^{\frac{\rho}{\rho-1}\frac{1}{1+\gamma}} \left(\frac{\beta_j i_l}{a_j}\right)^{\frac{1}{1+\gamma}} \tag{4}$$

$$p_{lj} = \gamma^{\frac{\rho}{\rho-1}\frac{\gamma}{1+\gamma}} \left(\beta_j i_l\right)^{\frac{\gamma}{1+\gamma}} a_j^{\frac{1}{1+\gamma}} \tag{5}$$

From equation (4) it is clear that the level of quality varies with income, this implies that firms produce different levels of quality for different markets.[8] As there are no fixed costs in producing quality, this variation of quality across markets is costless for firms. As there are no trade costs, firms in both countries can serve both markets. Assuming that at least one firm from country k exports to country l, the price p_{lj} is also the import price p_{klj} for goods going from country k to l. Hence, we get the following result:

Proposition 1 *When utility is expanding in both quantity and quality under constant returns to scale in production, higher income per capita leads to higher import prices.*

2.2.2 Income Inequality

In this section we introduce inequality. We focus on country l and suppress country indexes in the expressions below. As there are no fixed costs, firms produce different quality for each income group. The expressions for quantity q_{jg}, quality α_{jg} and price p_{jg} in sector j and in income group g are given in equations (3), (4) and (5) with a subscript g added to the variables q_{jg}, α_{jg} and p_{jg} and income i_g.

To address the effect of changes in income inequality, we consider the effect of changes in the Atkinson index of income inequality, defined as follows:

$$I_A(\theta) = 1 - \left(\frac{1}{G}\sum_{g=1}^{G}\left(\frac{i_g}{\bar{i}}\right)^{1-\theta}\right)^{\frac{1}{1-\theta}} \quad \text{with } \bar{i} = \frac{1}{G}\sum_{g=1}^{G} i_g \tag{6}$$

[8] An increase in γ, reflecting the cost of quality, raises (decreases) quality relative to quantity when $\rho < 1$ ($\rho > 1$).

As defined, the Atkinson index increases with rising inequality. To find the effect of a change in the Atkinson index on unit values, we sum prices across different income groups, weighted by their share of spending on good j. We assume that the fraction of firms producing in country k and selling in country l for the different income groups is proportional to the fraction of firms selling for the two income groups across the entire world economy. With this assumption, we get the following expression for unit values of trade from country k to country l in sector j:[9]

$$p_{klj} = \sum_{g=1}^{G} \omega_{ljg} p_{ljg} \tag{7}$$

With ω_{ljg} the share of good j consumed by group g in terms of volume, defined as:

$$\omega_{ljg} = \frac{q_{ljg}}{\sum_{g=1}^{G} q_{ljg}} \tag{8}$$

Substituting equation (8) into (7) leads to:

$$p_{klj} = \gamma^{\frac{\rho}{\rho-1}\frac{\gamma}{1+\gamma}} \beta_j^{\frac{\gamma}{1+\gamma}} a_j^{\frac{1}{1+\gamma}} \sum_{g=1}^{G} \frac{i_{lg}}{\sum_{g=1}^{G} i_{lg}^{\frac{1}{1+\gamma}}} \tag{9}$$

We can rewrite equation (9) as follows:

$$p_{klj} = \gamma^{\frac{\rho}{\rho-1}\frac{\gamma}{1+\gamma}} \beta_j^{\frac{\gamma}{1+\gamma}} a_j^{\frac{1}{1+\gamma}} \frac{\bar{i}_l^{\frac{\gamma}{1+\gamma}}}{\left(1 - I_{Al}\left(\frac{\gamma}{1+\gamma}\right)\right)^{\frac{1}{1+\gamma}}} \tag{10}$$

From equation (10) it follows directly that, for a given average income $\bar{i}_l$, an increase in the Atkinson index $I_{Al}\left(\frac{\gamma}{1+\gamma}\right)$ implies a larger average price p_{klj}. We summarize this result in the following proposition:

Proposition 2 *For a given average income $\bar{i}$, when utility is expanding in both quantity and quality under constant returns to scale in production, an increase in the Atkinson index of inequality as defined in equation (6), leads to higher average import prices.*

[9] Unit values (UV) are defined as value/volume implying that $UV = \sum p_i x_i / \sum x_i = \sum \omega_i p_i$ with $\omega_i = x_i / \sum x_i$

2.2.3 Income Inequality with Two Income Groups

To shed some light on the intuition of this result, we calculate the effect of an increase in income inequality in a setup with only two income groups H and L, modeled as an increase in the mean preserving spread of average income $i_l = \frac{i_{lH}H + i_{lL}L}{H+L}$.[10] Log differentiating p_{klj} with respect to shares ω_{ljG} and prices p_{ljG} gives:[11]

$$\widehat{p_{klj}} = \frac{\omega_{ljH}p_{ljH}\widehat{\omega_{ljH}} + \omega_{ljL}p_{ljL}\widehat{\omega_{ljL}}}{\omega_{ljH}p_{ljH} + \omega_{ljL}p_{ljL}} + \frac{\omega_{ljH}p_{ljH}\widehat{p_{ljH}} + \omega_{ljL}p_{ljL}\widehat{p_{ljL}}}{\omega_{ljH}p_{ljH} + \omega_{ljL}p_{ljL}} \tag{11}$$

To address the effect of an increase in the mean preserving spread shares ω_{ljG} and prices p_{ljG} are log differentiated with respect to i_{lH} and i_{lL} imposing $\widehat{i_{lL}} = -\frac{i_{lH}H}{i_{lL}L}\widehat{i_{lH}}$, to keep mean income constant. Using equations (3) and (5) with income group subscripts, we can re-write equation (11) as:

$$\widehat{p_{klj}} = (p_{ljH} - p_{ljL}) \frac{\frac{1}{1+\gamma} \frac{i_{lH}^{\frac{1}{1+\gamma}} H i_{lL}^{\frac{1}{1+\gamma}} L}{\left(i_{lH}^{\frac{1}{1+\gamma}} H + i_{lL}^{\frac{1}{1+\gamma}} L\right)^2} \frac{i_{lL}L + i_{lH}H}{i_{lL}L}}{\omega_{ljH}p_{ljH} + \omega_{ljL}p_{ljL}} \widehat{i_{lH}} \tag{12}$$

The coefficient of $\widehat{i_{lH}}$ in equation (12) represents the first terms in equation (11), i.e. the shift in market share towards higher priced goods. The second term in equation (11), the change in prices of the high and low quality good, is equal to zero. The shift in spending towards the higher quality goods consumed by the high incomes has a positive effect on the average price. There is less consumption of the low quality good and more consumption of the high quality good leading to an increase in the average price, because the price of the high quality good is higher. The effect through the changes in prices themselves with changed demand for quality, is zero. The price of high quality goods goes up, as the rich get more income, but the price of low quality goods goes down as the poor get less income and these two effects cancel out.

Although this framework is somewhat stylized, it catches the effect of income inequality on prices through expanded demand for quality which is also present in other models like Francois and Kaplan (1996). More income inequality increases average demand for quality, because the

[10] Notice that we include the possibility for different sizes of the two income groups, whereas in the calculation with the dispersion index, we assumed that all income groups are equal. With a general number of G income groups, we do not need to weigh by the size of income groups, as larger income groups can be considered as two separate income groups.

[11] Variables with a hat represent relative changes, $\widehat{x} \equiv dx/x$

share of high quality high priced goods increases, whereas the share of low quality low priced goods shrinks.[12] The implication is that the non-homothetic expansion in demand for quality clearly predicts that more income inequality should drive up average demand for quality and average unit values.

We should comment briefly on the implication of alternative specifications based on other quality models found in the international trade literature.[13] This includes the model by Flam and Helpman (1987) and an empirical application of this model to unit values and income distribution by Choi, Hummels and Xiang (2009), as well as the model proposed by Hallak (2006). Flam and Helpman (1987) consider a model with preferences over a single unit of a differentiated good of varying quality and a numeraire good. Choi, Hummels and Xiang (2009) find a direct mapping from the income distribution in an economy to the price distribution of the differentiated good. In the framework of Flam and Helpman (1987), we can show that a change in the Atkinson index has no impact on the average traded goods price within a sector. The reason is that demand is unitary implying that the mechanism driving the results in our model, an increase in income inequality raising the share of higher quality goods demanded by the rich consumers, is absent in the model of Flam and Helpman (1987). In contrast, the Hallak (2006) model, which features CES preferences within sectors with taste shifters (CES weights) varying across consumers reflecting higher demand for quality among richer consumers, is not suitable for our analysis. This is because the setup is too reduced form, with a demand system that does not satisfy homogeneity of degree zero in prices and income. Whereas this is not a problem for the empirical application in Hallak (2006), it would be so here as we need homogeneity to be able to determine the impact of income inequality on average prices.

[12] In an appendix available upon request, we examined alternatives to the basic setup, as a robustness check. We considered a setup where within each sector demand is Cobb Douglas or CES. The setup is as in the current framework, but within a sector each agent consumes all varieties. This setup does not change the main result that an increase in inequality leads to higher average prices within a sector (an average across several varieties for each consumer). The mechanism is the same: an increase in inequality leads to more consumption of high quality goods and less consumption of low quality goods, implying an increase in average prices.

[13] While not shown here, derivations of the results discussed below are also available upon request.

2.3 Hierarchic Demand

2.3.1 Basics

Next we focus on the effect of income and income inequality on unit values through its effect on the price elasticity and optimal markup of firms. We work with the same setup as in the first model. There are two countries identical in all aspects except income and income distribution and there are no trade costs. Country subscripts are omitted in the exposition of the model. We proceed by outlining a mechanism where as people become richer, more goods become indispensable in their consumption bundle. This decreases the price elasticity of these goods and thus raises its markup in an imperfect competition setting. We use the following Linear Hierarchic Expenditure System (LHES) utility function first proposed by Jackson (1982) to model this notion:

$$U = \int_{j \in I} \ln\left(q_j + \gamma_j\right) dj; \ \gamma_j > 0 \tag{13}$$
$$q_j = \left(\sum_{s=1}^{n_j} q_{sj}^{\frac{\sigma-1}{\sigma}} \right)^{\frac{\sigma}{\sigma-1}}$$

In equation (13), q_j is the demand for sector j goods, and I is the endogenous set of sectors in which agents can consume. As income increases, agents extend the number of sectors from which they consume. Preferences characterized by this utility function are similar to the well-known Stone-Geary utility function, where the γ_j's have a negative sign. In our framework with positive γ_j's the intercept of the income expansion line with the vertical axis is negative. Therefore, as income rises, consumers extend their set of goods consumed. Lower tier utility is CES with substitution elasticity σ. We assume $\sigma > 1$. There is monopolistic competition between a small group of identical firms n_j producing each q_{sj}. Firm s in sector j has the following cost function

$$C\left(q_{sj}\right) = \left(a_j q_{sj} + f_j\right)$$

We assume that $a_j \gamma_j$ is increasing in j, i.e. when we get higher up in the hierarchy the product of the Stone Geary intercept γ_j and marginal cost a_j is increasing. The firms can be based in one of the two countries. Important is that the fixed costs f_j have to paid for sales in each of the two markets. As we work with the assumption of no trade costs, the fixed costs are equal

for domestic and foreign producers.

Demand within each sector q_{sj} is equal to:

$$q_{sj} = \frac{p_j^{\sigma-1}}{p_{sj}^{\sigma}} E_j;\ p_j = \left(\sum_{s=1}^{n_j} p_{sj}^{1-\sigma} \right)^{\frac{1}{1-\sigma}} \tag{14}$$

p_j is the price index of composite j and E_j income spent on composite j, $E_j = p_j q_j$. Maximizing utility in (13) s.t. the budget constraint $\int\limits_{j \in I} p_j q_j dj = i$ generates the following expression for sectoral demand q_j:

$$q_j = \frac{\frac{1}{J}\left(i + \int\limits_0^J \gamma_m p_m dm \right)}{p_j} - \gamma_j;\ j \in \widetilde{J} \tag{15}$$

$\widetilde{J}$ is the set of goods that are consumed in positive amounts with a corresponding mass J of goods in the set. The price elasticity of composite j, ε_j, can be derived easily from equation (15) as:

$$\varepsilon_j = 1 + \frac{\gamma_j}{q_j} \tag{16}$$

The number of firms within each sector j is small. This implies that the price elasticity facing an individual firm is not constant. It can be shown that the price elasticity of firm s in sector j, ε_{sj}, is equal to:

$$\varepsilon_{sj} = \sigma \frac{n_j - 1}{n_j} + \frac{1}{n_j} \varepsilon_j \tag{17}$$

Log differentiating this expression, we can show that the price elasticity facing firm s in sector j declines in income i as follows:[14]

$$\widehat{\varepsilon_{sj}} = -\frac{n_j \left(\varepsilon_j - 1\right)\left(\varepsilon_{sj} - 1\right)}{n_j^2 \left(\varepsilon_{sj} - 1\right)\varepsilon_{sj} + \varepsilon_j \left(\varepsilon_j - 1\right)} \eta_{q_j,i} \widehat{i} \tag{18}$$

With $\eta_{q_j,i}$ the income elasticity of demand is given by equation (19).

$$\eta_{q_j,i} = \frac{\beta_j i}{\beta_j i + \beta_j \int\limits_0^J \gamma_m p_m dm - \gamma_j p_j \int\limits_0^J \beta_m dm} \tag{19}$$

[14] q_j is a function of the price p_j and therefore a function of the price elasticity. We have to take this endogenous effect of a larger income into account: a larger income reduces the price elasticity which raises the price of individual firms, reducing sales and thus raising the price elasticity. This indirect effect reduces the effect of a higher income on the price elasticity.

There is also an indirect effect of i on q_j, when the budget set is extended which should be a part of the income elasticity. It can be shown that this effect is 0. Hence, given markup pricing, higher incomes lead to a smaller price elasticity, a larger markup and a higher price:

$$\begin{aligned}\widehat{p_{sj}} &= -\frac{1}{\varepsilon_{sj}-1}\widehat{\varepsilon_{sj}} \\ &= \frac{n_j\left(\varepsilon_j-1\right)}{n_j^2\left(\varepsilon_{sj}-1\right)\varepsilon_{sj}+\varepsilon_j\left(\varepsilon_j-1\right)}\left(\frac{\beta_j i}{\beta_j i+\beta_j\int_0^J\gamma_m p_m dm-\gamma_j p_j\int_0^J\beta_m dm}\right)\widehat{i}\end{aligned}$$

Like in the quality model, firms from both countries can serve both markets. Assuming that at least one firm exports from one country to the other, the price p_{sj} is also the import price of a country. Hence, we have derived the following result without imposing a free entry condition and thus valid in the short run:

Proposition 3 *With hierarchic demand, a larger income per capita leads in the short run to higher import prices through a decrease in the price elasticity of demand.*

To address the effects in the long run, we have to impose a free entry condition. This will endogenize the number of firms n_j. To solve for equilibrium sales q_{sj} and number of firms n_j in sector j, we start by combining markup pricing and zero profit to get to the following expression:

$$\left.\begin{aligned}p_{sj} &= \tfrac{\varepsilon_{sj}}{\varepsilon_{sj}-1}a_{sj} \\ p_{sj}q_{sj} &= \left(a_{sj}q_{sj}+f_{sj}\right)\end{aligned}\right\} q_{sj}=\left(\varepsilon_{sj}-1\right)\frac{f_{sj}}{a_{sj}} \tag{20}$$

In standard monopolistic competition models the system is closed by combining equation (20) with labor market equilibrium. As there is more than one sector and the uppertier utility function is non-homothetic, we have to take into account that the budget share of sector j is not constant. Labor market equilibrium in sector j is given by:

$$\left(a_{sj}q_{sj}+f_{sj}\right)n_j=\chi_j\left(i,p_1,...,p_I\right)iL \tag{21}$$

With χ_j the share of labor used in sector j, being a function of prices in the different sectors and income.

In an economy with non-constant budget shares across sectors (as with our Stone Geary upper nest preferences) and with love for variety in each sector (as with our CES lower nest preferences), there are in general multiple equilibria. The reason for multiple equilibria is that there are increasing returns to variety within each sector (Francois and Nelson, 2002). We can find the equilibria by combining a demand equation and a supply equation with the expression for the price elasticity. Define the following supply equation from the definition of the sectoral price p_j, substituting equations (20) and (21)

$$p_j = n_j^{\frac{1}{1-\sigma}} p_{sj} = \left(\frac{\varepsilon_{sj} f_{sj}}{p_j q_j} \right)^{\frac{1}{\sigma-1}} a_{sj} \frac{\varepsilon_{sj}}{\varepsilon_{sj} - 1} \tag{22}$$

Combining equations (15)-(17) and (22) we can find a solution for p_j, q_j, ε_j and ε_{sj}. To address the effect of a higher income on the price elasticity, we can log differentiate the same set of equations and solve for the relative change in the price elasticity ε_{sj} as a function of the relative change in income i. This leads us to the following results:

$$\widehat{\varepsilon_{sj}} = A_j B_j \eta_{q_j,i} \widehat{i} \tag{23}$$

$$A_j = \frac{n_j \left(\varepsilon_{sj} - 1 \right)}{\left(n_j^2 \sigma \left(\sigma - 1 \right) + \left(n_j - 1 \right) \sigma \varepsilon_j - \sigma \left(n_j \sigma - 1 \right) + 2 \varepsilon_j \left(\varepsilon_j - 1 \right) \right)} \tag{24}$$

$$B_j = \sigma - \varepsilon_j - \frac{\varepsilon_j \left(\varepsilon_j - 1 \right)}{\left(\sigma - \varepsilon_j \right)} \tag{25}$$

As $n_j \geq 1$, A_j is positive. Hence, the effect of income on the price elasticity depends upon the relative size of σ and ε_j in B_j. The following can be shown:

$$B_j < 0 \iff \frac{\sigma^2}{2\sigma - 1} < \varepsilon_j < \sigma \tag{26}$$

Hence, we find that B_j is negative for intermediate values of σ, i.e. when σ is large enough to exceed ε_j, but not so large that $\sigma^2/(2\sigma - 1)$ exceeds ε_j. Otherwise B_j is positive.

There are two effects of a higher income. First, there is a direct effect of a higher income on the sectoral price elasticity. Higher incomes mean higher quantity consumed in sector j and thereby a lower price elasticity facing the sector. This also reduces the price elasticity of individual firms. Second, there is an indirect, resources effect with a higher income increasing

the amount of resources allocated to sector j. This raises the number of firms in the sector and therefore increases the price elasticity. The direct effect dominates the resources effect if B_j is negative, implying that a higher income decreases the price elasticity and thus raises the price.

We summarize our findings in the following proposition:

Proposition 4 *If $\sigma^2/(\sigma-1) < \varepsilon_j < \sigma$, with hierarchic demand a higher income per capita i leads to higher import prices in the long-run through a decrease in the price elasticity. Otherwise, this leads to lower prices.*

In the first part of proposition 4 we refer to the case where the direct effect dominates the resources effect: the price elasticity goes down and prices go up with a higher income. The resource effect dominates if σ is large enough to satisfy the condition $\sigma^2/(\sigma-1) > \varepsilon_j$. A larger σ means that the effect of an increase in the number of firms on the price elasticity becomes larger, so the pro-competitive effect of more income on the price elasticity is larger. And a relatively small ε_j means that the impact of a change in income i on the sectoral price elasticity ε_j, the direct effect, becomes smaller.

2.3.2 Income Inequality

We now address the effect of changes in income inequality. There are G income groups of equal group size with income i_g. Like above we start with the effect in the short run.

Suppressing again the country subscript l, total demand for sector j goods in country l is equal to:

$$q_j = \sum_{g=1}^{G} q_{jg} = \sum_{g=1}^{G} \frac{\frac{1}{J_g}\left(i_g + \int_0^{J_g} \gamma_m p_m dm\right) - \gamma_j p_j}{p_j} \tag{27}$$

Hence, q_{jg} denotes individual demand in group g. Notice from equation (27) that there is only one price for the different income groups, as the product is identical and the market cannot be segmented between income groups. The price elasticity is a weighted sum of the price elasticities of the different income groups. Log differentiating equation (27) with respect to the market price p_j generates the following expression for the aggregate price elasticity ε_j:

$$\varepsilon_j = 1 + \frac{\gamma_j G}{q_j} \tag{28}$$

To derive the effect of the Atkinson index on the price elasticity in equation (31), we first rewrite the expression for q_j in equation (27) as follows:

$$q_j = \frac{1}{p_j} \sum_{g=1}^{G} f(i_g) - \gamma_j \tag{29}$$

$$f(i_g) = \frac{1}{J_g} \left(i_g + \int_0^{J_g} \gamma_m p_m dm \right) \tag{30}$$

Therefore, substituting equation (29) into equation (28), we can write the price elasticity as follows.

$$\varepsilon_j = 1 + \frac{p_j \gamma_j G}{\sum_{g=1}^{G} f(i_g) - \gamma_j p_j} \tag{31}$$

Log differentiating equations (28) and (31) with p_j treated as an endogenous variable gives:

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j} \widehat{q_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left(-\varepsilon_j \widehat{p_j} + \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f(i_g)} \right) \tag{32}$$

Like in the subsection without inequality we can solve for the relative change of ε_{sj} treating p_j as endogenous:

$$\widehat{\varepsilon_{sj}} = -\frac{n_j (\varepsilon_{sj} - 1)(\varepsilon_j - 1)}{n_j^2 \varepsilon_{sj} (\varepsilon_{sj} - 1) + \varepsilon_j (\varepsilon_j - 1)} \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f(i_g)} \tag{33}$$

The final step is to show that the Atkinson index is monotonic in $\sum_{g=1}^{G} f(i_g)$ for given average income. We prove this in two steps. First, we show that $f(i_g)$ is strictly concave in i_g. Differentiating $f(i_g)$ in equation (30) with respect to income i_g gives:

$$\frac{\partial f(i_g)}{\partial i_g} = \frac{1}{J_g}$$

We have used that the change in J_g does not effect $f(i_g)$, as discussed below equation (19).

The second derivative of $f(i_g)$ is given by:

$$\frac{\partial^2 f(i_g)}{\partial i_g^2} = -\frac{1}{J_g^2} \frac{\partial J_g}{\partial i_g}$$

J_g strictly increases in i_g (shown in Appendix B). Therefore, the second derivative is strictly

negative.

Second, the strict concavity of $f(i_g)$ implies that $\sum_{g=1}^{G} f(i_g)$ decreases monotonically in the Atkinson index for given average income. The fact that both $f(i_g)$ and the function $i_g^{1-\theta}$ appearing in the Atkinson index rise strictly concave in i_g implies that the sum $\sum f(i_g)$ is monotonically increasing in the sum $\sum_{g=1}^{G} i_g^{1-\theta}$ for given average income and thus monotonically decreasing in the Atkinson index $I_A = 1 - \left(\frac{1}{G} \sum_{g=1}^{G} \left(\frac{i_g}{\bar{i}} \right)^{1-\theta} \right)^{\frac{1}{1-\theta}}$ for given average income $\bar{i}$.

From equation (33) the price elasticity thus rises in the Atkinson index. Therefore, we have proved the following result:

Proposition 5 *In the short-run, for a given level of average income under hierarchic demand, higher income inequality as measured by the Atkinson index means a greater price elasticity and hence reduced import prices for goods consumed by all income groups.*

This result holds only when there is no change in the number of groups that consumes the good under consideration. We postpone a discussion of this point to the derivation of the effect of an increase in the mean preserving spread with two income groups.

In the long run we add a free entry condition, endogenizing the number of firms n_j. To find the effect of a change in the Atkinson index, we log differentiate the same equations as in the basic model without inequality, replacing equation (15) by (29). With some manipulation, the price elasticity can be expressed as follows:

$$\widehat{\varepsilon_{sj}} = A_j B_j \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f(i_g)} \tag{34}$$

A_j and B_j are defined in equations (24) and (25). From the short run analysis we know that the Atkinson index is (negative) monotonic in $\sum_{g=1}^{G} f(i_g)$ for given average income. Therefore, we have the following result (analogous to the basic model):

Proposition 6 *In the long-run, for a given level of average income under hierarchic demand, higher income inequality as measured by the Atkinson index leads to a greater price elasticity and hence reduced import prices for goods consumed by all income groups if* $\sigma^2/(\sigma - 1) < \varepsilon_j < \sigma$. *Otherwise it means higher import prices.*

Again, there are two effects: a direct effect on the sectoral price elasticity and an indirect resources effect through the number of firms. The direct effect of an increase in the Atkinson index is that spending on sector j, q_j, drops, leading to a higher price elasticity. By the resources effect the number of firms falls reducing the price elasticity. As before, the direct effect dominates if $\sigma^2/(\sigma-1) < \varepsilon_j < \sigma$.

2.3.3 Income Inequality with Two Income Groups

Again, we turn to the case of 2 income groups. These 2 income groups have units of labor i_H and i_L and the number of these workers is respectively H and L. We address the effect of an increase in the mean preserving spread. This means we examine the effect of a change in i_H with the corresponding change in i_L equal to $\widehat{i_L} = -\frac{i_H}{i_L}\widehat{i_H}$. We focus on effects in the short run. As the 2 income groups case does not provide additional intuition on long run effects with the same effects appearing as in the G income groups case, we do not present the long run effects of inequality with 2 income groups.

Log differentiating (28) with respect to i_H imposing $\widehat{i_L} = -\frac{i_H H}{i_L L}\widehat{i_H}$, we find the following effect of an increase in the mean preserving income spread on the price elasticity:

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j}\frac{q_{j,H}H\eta_{q_{j,H},i_H} - q_{j,L}L\eta_{q_{j,L},i_L}\frac{i_H}{i_L}}{q_{j,H}H + q_{j,L}L}\widehat{i^H} \tag{35}$$

Equation (35) can be rewritten as follows:

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j}\left(\frac{1}{J_H} - \frac{1}{J_L}\right)\frac{\beta_j H i_H}{p_j q_j}\widehat{i^H} \tag{36}$$

Equation (36) shows that the price elasticity rises with income inequality, because $J_H > J_L$. Hence, the price declines in income inequality. This result can be explained as follows. From equation (28) the price elasticity of good j is a function of the amount consumed of good j, q_j. When inequality goes up the demand by high income groups goes up and the demand by low income groups goes down. Because the income elasticity of low incomes is higher, the decline in demand for q_j as a result of the smaller i_L is larger than the increase in demand as a result of the higher i_H. Therefore, demand for q_j goes down leading to a higher price elasticity.

Another way to understand this result is that an increase in income leads both to more consumption of each good q_j and a larger consumption set. When inequality goes up holding constant average income, the set of goods consumed rises and the amount consumed of each variety goes down. As a result the price elasticity goes up and the markup firms can charge goes down.

There is an important qualification to the finding that the market price declines in income inequality. When the low income group does not consume a certain commodity, the only effect of an increase in income inequality is that demand for that good rises as a result of the higher income of the high income group. This reduces the price elasticity and thus raises the market price. We summarize these results in the following proposition:[15]

Proposition 7 *With hierarchic demand and two income groups, for goods consumed exclusively by the high income group, an increase in income inequality as measured by an increase in the mean preserving spread reduces the price elasticity and raises the market price*

To summarize, we find that for goods lower in the consumption hierarchy the effect of income inequality on market price through the elasticity channel is opposite to the effect of income inequality through the quality channel and for goods high in the consumption hierarchy the effect of income inequality on market price through the price elasticity channel has the same sign as the effect through the quality channel.

2.4 Ideal Varieties

2.4.1 Basics

A third framework to link higher income per capita in an importing country to a lower price elasticity is the ideal varieties framework of Lancaster (1979). We build on an extension of that framework proposed by Hummels and Lugovskyy (2009), where higher incomes are willing to pay more to get closer to their ideal variety. This makes them less price sensitive and the price elasticity is thus lower and firms can charge higher markups as people switch less easily

[15] This effect is similar to what Markusen (2010) finds in a two good model with Stone Geary preferences and with two income groups, where only one of the income groups consumes the luxury good. In the general case of many groups, how inequality impacts prices when a good is exclusive to a subset of income groups cannot be determined analytically, and one must resort to numerical simulation.

between varieties. To differentiate the ideal varieties framework from the other frameworks in this paper, we expand the ideal varieties framework to address not only the role of income levels, but also the effect of income inequality for a given level of income. We show that the price elasticity declines and the market price rises with income inequality. This result means the effect of income inequality on the market price (and unit values) has the same sign as in the quality specification but the opposite sign from the hierarchic demand specification.

Hummels and Lugovskyy (2009) introduce an additional term in the distance compensation function to catch the effect of a higher finickyness (eagerness) to buy the ideal variety as income rises. Basically, finickyness rises with the amount consumed. In Hummels and Lugovskyy (2009) agents consume only one variety, i.e. there is no upper nest with a Lancaster circle in the lower nest. A model with preferences over more products is not feasible in the model of Hummels and Lugovskyy (2009) as the upper nest optimization depends upon the amount consumed and thus upon the lower nest compensation function. Therefore, we extend the ideal varieties model in a different way by creating a Cobb Douglas uppernest and including a finickyness effect in the compensation function that is a function of total consumption, i.e. not only of consumption of the specific variety. When people consume only one variety, the results from this framework collapse to the same results as in the original model of Hummels and Lugovskyy (2009).

We again start with 2 countries identical in all aspects except income and income distribution. There are no trade costs, the setup is identical as in the other two frameworks. In the exposition below country subscripts are omitted. We have the following preferences for consumption across sectors j:

$$U = \sum_{j=1}^{J} \beta_j \ln u_j \tag{37}$$
$$u_j = \int_{\omega_j \in \Omega_j} \frac{q_j}{h_j\left(\delta\left(\omega, \tilde{\omega}\right)\right)}$$

We specify the compensation function h_j for the cost of being further away from the ideal variety as rising in total income i and rising in distance δ from the ideal variety:

$$h_j\left(\delta, i\right) = 1 + i^v \delta^{\psi};\ v < 1;\ \psi > 1 \tag{38}$$

It can be shown that an increase in income leads to a higher indirect utility as long as $v < 1$. Therefore we impose this restriction. There are G different income groups with group g having income i_g, like in the other two frameworks. All income groups are distributed uniformly across the circle. The cost function for production of a variety j is equal to:[16]

$$C(q_j) = a_j q_j + f_j$$

It can be shown[17] that with this specification there exists a symmetric zero profit equilibrium like in Hummels and Lugovskyy (2009) with aggregate demand for any produced variety q_j equal to:

$$q_j = d_j \sum_{g=1}^{G} i_g \frac{\beta_j}{p_j} \tag{39}$$

In equation (39), d_j is the equal distance between any two varieties. The price elasticity facing a firm consists of two components, one with a direct effect of price on demand and the other with an effect through distance d_j, and is equal to:

$$\varepsilon_j = 1 + \frac{\sum_{g=1}^{G} i_g \left(1 + \frac{1}{i_g^v \left(\frac{d_j}{2}\right)^{\psi}}\right)}{2\psi \sum_{g=1}^{G} i_g} \tag{40}$$

This expression can be rewritten as a function of average income $\bar{i}$ and the Atkinson index $I_A(v)$:

$$\varepsilon_j = 1 + \frac{1}{2\psi} + \frac{1}{2\psi \left(\frac{d_j}{2}\right)^{\psi}} \frac{(1 - I_A(v))^{1-v}}{\left(\bar{i}\right)^{v}} \tag{41}$$

As $v < 1$, an increase in the inequality as measured by the Atkinson index leads to a lower price elasticity and hence to a higher price for given distance d_j, as is clear when we log differentiate equation (41):

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1 - \frac{1}{2\psi}}{\varepsilon_j} \left(\psi \widehat{d_j} + (1 - v) \frac{I_A}{1 - I_A} \widehat{I_A} + v\widehat{\bar{i}}\right) \tag{42}$$

[16] As there are no trade costs and technologies are identical, firms are indifferent about production location.

[17] Derivations are analogue to the derivation in Hummels and Lugovskyy (2009) and in Helpman and Krugman (1985).

In the long run, when n_j is endogenous, we add the following zero profit condition:

$$d_j = \frac{f\varepsilon_j}{\sum_{g=1}^{G} i_g \beta_j} \tag{43}$$

Log differentiating equation (43) and substituting into (42), yields the long run change in the price elasticity:

$$\widehat{\varepsilon_j} = \frac{\varepsilon_j - 1 - \frac{1}{2\psi}}{(\psi+1)\,\varepsilon_j - \psi - \frac{1}{2}} \left(\psi \widehat{G\bar{i}} - (1-v)\,\frac{I_A}{1-I_A}\widehat{I_A} - v\widehat{\bar{i}} \right) \tag{44}$$

In equation (44), $G\bar{i}$ is total income, i.e. the number of agents times average income. Equation (44) shows the same effects as in Hummels and Lugovskyy (2009), i.e. a larger market $G\bar{i}$ raises the price elasticity and a larger income per capita $\bar{i}$ reduces the price elasticity. However there is also an additional determinant of the price elasticity. A higher level of inequality as measured by a higher Atkinson index I_A leads to a lower price elasticity. Notice that the effect is stronger in the long run, because of the endogenous response in the number of firms (distance between firms). We summarize our findings in the following proposition:

Proposition 8 *With ideal varieties as in Hummels and Lugovskyy (2009), an increase in income inequality as measured by an increase in the Atkinson index causes a decrease in the price elasticity of demand and an increase in the market price.*

2.4.2 Income Inequality with Two Income Groups

We also derive the effect of a larger income inequality with two income groups to provide some intuition for our results. We log differentiate equation (40) with two income groups with respect to i_H and i_L with the condition $\widehat{i_L} = -i_H H / i_L L \widehat{i_H}$ and keeping the number of firms n_j and hence distance d_j fixed, generating the following result:

$$\widehat{\varepsilon_j} = \frac{\varepsilon_j - 1}{\varepsilon_j} \frac{\frac{i_H H}{\left(\frac{d_j}{2}\right)^{\psi}} (1-v) \left(\left(\frac{1}{i_H}\right)^{v} - \left(\frac{1}{i_L}\right)^{v} \right)}{i_H H \left(1 + \frac{1}{i_H^{v} \left(\frac{d_j}{2}\right)^{\psi}} \right) + i_L L \left(1 + \frac{1}{i_L^{v} \left(\frac{d_j}{2}\right)^{\psi}} \right)} \widehat{i_H} \tag{45}$$

As $i_H > i_L$ and $v < 1$, an increase in the mean preserving spread reduces the price elasticity and hence increases the market price. Taking into account equation (43), we find that also in the long run the price elasticity decreases when the mean preserving spread rises:

$$\widehat{\varepsilon_j} = \frac{\frac{i_H H}{\left(\frac{d_j}{2}\right)^{\psi}}(1-v)\left(\left(\frac{1}{i_H}\right)^{v} - \left(\frac{1}{i_L}\right)^{v}\right)}{\frac{\varepsilon_j}{\varepsilon_j - 1}\left(i_H H\left(1 + \frac{1}{i_H^{v}\left(\frac{d_j}{2}\right)^{\psi}}\right) + i_L L\left(1 + \frac{1}{i_L^{v}\left(\frac{d_j}{2}\right)^{\psi}}\right)\right) + \frac{i_L^{1-v} L + i_H^{1-v} H}{\left(\frac{d_j}{2}\right)^{\psi}}} \widehat{i_H} \tag{46}$$

The result that an increase in income inequality reduces the overall price elasticity can be explained as follows. The overall price elasticity is a weighted average of the price elasticity of the high and the low income group. An increase in the mean preserving spread increases the price elasticity of the low income group and decreases the price elasticity of the high income group. On net this leads to a higher price elasticity. But the weights of each group in total demand also change. The weight of the low price elasticity of the high income group rises, whereas the weight of the high price elasticity of the low income group drops. This weights effect dominates the effect on the price elasticity of the different groups and as a result the overall elasticity increases.

The weights effect dominates the change in the price elasticities of the different income groups if $v < 1$. We assumed $v < 1$ to guarantee that indirect utility rises in income. v measures the effect of income on the cost of distance in the compensation function and thus on the price elasticity. A smaller v means that the price elasticity decreases less in response to a higher income. This makes clear that the assumption $v < 1$ puts a cap on the second effect through the changes in the price elasticity of the different income groups.

The finickyness of consumers to get closer to their ideal variety rises with income in the theory of this subsection. This finickyness cannot rise by so much that utility would be decreasing in income. This implies that the price elasticity cannot drop too much as income goes up. Therefore, the weights effect of an increase in inequality giving more weight to the low elasticity of the high incomes dominates the direct effect on the price elasticities of the different groups.

3 Data and Estimation Method

Having mapped the impact of inequality on import prices in theory, we now turn to an empirical analysis of the impact of income and income inequality on import prices. More precisely, we examine how the unit value of imported disaggregated product categories changes with the income, income per capita and income inequality of the importer country.

In our empirical analysis we proxy prices with import unit values. The data used for unit values come from the BACI database [18] which contains quantity and the value of bilateral imports in 6-digit Harmonized System (HS) classification. The database is constructed from COMTRADE (Commodities Trade Statistics database) and it covers more than 100 countries and 5,000 products. We use data for the period between 2000-2004. We deflate our unit value data by the importer country's gdp deflator. BACI takes advantage of the double information on each trade flow to fill out the matrix of bilateral world trade providing a "reconciled' value for each flow reported at least by one of the partners. Therefore the missing values in BACI are those concerning trade between non reporting countries.

We work with those HS product categories which are used for final consumption. In this section we briefly describe our data, leaving to the appendix a more detailed documentation of how we classified goods into final goods, luxuries, and necessities.

To classify products as being destined for final consumption we used a classification scheme developed for the ongoing update to the EU-KLEMS database, known as the World Input Output Database or WIOD (Francois et al, 2010). The result is 1260 HS6 product lines classified as final consumption goods out of a total of 5703 product lines (the remaining products are used for intermediate consumption mostly as inputs into further production or could be used both for intermediate and final consumption). We further distinguish between luxuries and necessities within final goods using the same methodology as Dalgin, Mitra and Trindade (2008) and using data from Eurostat's Household Budget Surveys

Our income and income per capita data originate from the World Bank's World Development Indicator database. We use constant GDP and GDP per capita as a measure of income and income per capita.[19] We also use a measure of income inequality in our regressions. To measure

[18] http://www.cepii.fr/anglaisgraph/bdd/baci/baciwp.pdf
[19] The base year for the constant GDP and GDP per capita variables is 2000.

income inequality we constructed an Atkinson index.[20] The data mainly come from the World Banks' World Development Indicator database. As for some of the EU countries data were not available for certain years, we supplemented this data with data from Eurostat for EU member countries. Furthermore, for some countries the Luxembourg Income Study had a better coverage for the Atkinson index thus we supplemented our dataset with data from the Luxembourg Income Study.[21]

We employ a fixed effects estimation based upon the theoretical discussion above. We include exporter-time-product specific fixed effects and importer-exporter-product fixed effects to control for unobserved heterogeneity in exporter characteristics like in Schott (2004) and in price measures of different product categories. The importer-exporter-product fixed effect contains an importer time invariant fixed effect. Following our analytical results, we also include income per capita and income inequality as explanatory variables of import prices. As a control variable we add total income, based upon the theoretical and empirical analysis in Hummels and Lugovskyy (2009). Given the theoretical results above, the explanatory variables affect unit values non-linearly. Therefore, we have the following equation to be estimated:

$$P_{kltj} = e_{ktj} b_{klj} f(Y_{lt}, Y_{lt}/L_{lt}, A_{lt}) \varepsilon_{kltj} \tag{47}$$

In equation (47) the subscript k stands for exporter, l for importer, j for product, and t for time. e_{ktj} captures any exporter-time-product specific effect on prices. b_{klj} captures bilateral country-pair-product specific influences. f is a non-linear function. In the three theoretical frameworks explored above, unit values are a non-linear function of per capita income, Y/L_{kt}, income inequality as measured by the Atkinson coefficient, A_{lt}, and total income, Y_{lt} (in the ideal variety specification) . These variables have their effects through the different channels mentioned in the theory section, so both through exporter destination specific variations in quality and in markups.

[20] The Atkinson index is calculated according to equation (6) using five income groups with the parameter θ equal to 1 implying $I_A = 1 - 5\left(\prod_{i=1}^{N} IS_i\right)^{\frac{1}{5}}$ as Atkinson index with IS_i the income share of the i-th income group.

[21] More information on the Luxembourg Income Study can be found on the following website: http://www.lisproject.org/. We also interpolated the data to reduce the number of missing values. As a robustness check we run our regressions using only non-imputed data and obtained very similar results. As a further robustness check, we also run our regressions using the atkinson index obtained only from the World Bank's dataset and we again obtained very similar results.

We approximate the non-linear function f by a log-linear function which allows us to write log import prices as follows:

$$\ln P_{kltj} = \ln e_{ktj} + \ln b_{klj} + \beta_1 lnY_{lt} + \beta_2 lnY_{lt}/L_{lt} + \beta_3 lnA_{lt} + \ln \varepsilon_{kltj} \tag{48}$$

The quality expansion and ideal variety models predict that inequality has a different impact on import prices of necessity and luxury goods. On the other hand, according to the hierarchic demand model, this would only be the case if luxuries are only consumed by rich, and necessities are only consumed by poor people. Thus we first run equation (48) on a sample with all final good products, and then we also provide results of estimates distinguishing the impact of the Atkinson index on import prices in the case of necessity and luxury goods.

We estimate equation (48) over the period 2000-2004. Given the high dimensionality of these fixed effects we could not include dummies in the OLS regressions directly. Furthermore, as our panel is unbalanced, we also could not include these fixed effects implicitly by calculating the appropriate deviations from means. Thus we employ the Stata program 'gpreg', developed by Johannes F. Schmiedera, which is based on the linear regression procedure developed by Guimaraes and Portugal (2009). The procedure allows to implement a full Gauss-Seidel algorithm to estimate linear regression models with high-dimensional fixed-effects, providing correct standard errors.

As a robustness check we also estimate a second order logarithmic approximation, i.e. including squares of logs and interaction terms in equation (48).

4 Results

Table 1 presents the results of estimation of equation (48) on a sample containing only goods destined for final consumption. The specification includes exporter-product-time and importer-exporter-product fixed effect. Since our main variables of interest are importer-time-product specific we do not include fixed effects for this dimension.

Column 1 of Table 1 displays the results of estimating the log linear equation on a sample containing all goods destined for final consumption. The results provide support for the three

	Sample with all final goods	Quadratic Equation, all final goods	Marginal effects, all final goods
ln GDP	-1.388	-2.623	-1.187
	(0.051)***	(0.513)***	(0.055)***
ln GDP/capita	1.058	2.705	1.256
	(0.049)***	(0.546)***	(0.051)***
ln Atkinson	-0.151	1.793	-0.219
	(0.008)***	(0.125)***	(0.011)***
$(\ln(GDP/Capita))^2$		0.224	
		(0.019)***	
$(\ln(GDP))^2$		0.036	
		(0.015)***	
$(\ln(Atkinsonindex))^2$		-0.103	
		(0.012)***	
$\ln(GDP/Capita) * \ln(GDP)$		-0.104	
		(0.032)***	
$\ln(GDP/Capita) * \ln(Atkinsonindex)$		-0.147	
		(0.007)***	
$\ln(GDP) * \ln(Atkinsonindex)$		0.204	
		(0.012)***	
R-sq	0.001	0.001	
Observations	4959542	4959542	

Robust standard errors in parentheses.
R-squared does not account for the fixed effects included in the regression.
Exporter-year-product, importer-exporter-product fixed effects are included in the regressions.
Column 3 presents the marginal effects for the results presented in Column 2.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 1: Estimation Results for all final goods

frameworks in this paper. Unit values rise in the importer country's income per capita. The results also confirm the findings of Hummels and Lugovskyy (2009) that a larger market size of the importer, as proxied by total GDP, reduces unit values. The size of the effect of income per capita on unit values is somewhat higher, 1.06, than the coefficient found by Hummels and Lugovskyy (2009). We also find a somewhat higher impact of total income on unit values than found by Hummels and Lugovskyy (2009). While our coefficient is around -1.38, Hummels and Lugovskyy (2009) obtained a weighted average coefficient which is larger, -0.5. This difference might partly come from the different sample we use. We have a sample containing a much wider range of exporter countries (we have 115 exporters) which includes not only high-income countries while the data used by Hummels and Lugovskyy (2009) come from the Eurostat's Trade Database and contains data of 11 EU exporters and 200 importers worldwide. We also have limited our sample to goods clearly destined for final consumption.

To discriminate between the different mechanisms, we also estimated the effect of income inequality in the importer country on unit values. We find a highly significant negative effect of income inequality as measured by the Atkinson index on unit values. This finding provides support for the hierarchic demand specification, that predicts a lower import price in response to higher inequality for goods consumed by all income groups. The quality specification with utility rising in quality and the ideal variety specification both predict a positive effect of inequality on import prices. Our interpretation is that these empirical findings do not falsify the quality and ideal variety framework but they do indicate that hierarchic demand model deserves a place as well.

Column 2 of Table 1 contains the results of the estimation with (log) square and interaction terms included. The marginal effects are presented in Column 3 of Table 1. The findings support the estimation outcomes of the log linear model. The size of the country has a negative impact on import prices, GDP per capita on the other hand has a price increasing effect. Income inequality is again found to be negatively influencing prices. The coefficient of GDP and GDP per capita is similar to the non-quadratic specification, while the coefficient of the atkinson index is somewhat larger.

Next, we distinguished luxury and necessity products, and limited the sample only to these goods. In order to test whether income inequality has a different impact on import prices in

	Sample with necessities and luxuries	Sample with necessities and strict luxuries
ln GDP	-1.063	-2.741
	(0.058)***	(-0.077)***
ln GDP/capita	0.929	2.286
	(0.056)***	(0.075)***
ln Atkinson necessities	-0.115	-0.085
	(0.015)***	(0.012)***
ln Atkinson luxuries	-0.215	-0.092
	(0.012)***	(0.036)***
Observations	3212997	1827349

Robust standard errors in parentheses
Exporter-year-product, importer-exporter-product fixed effects are included in the regressions
* significant at 10%; ** significant at 5%; ***significant at 1%

Table 2: Estimation Results for luxuries and necessities

the case of luxury and necessity goods, the atkinson variable can now take different values in the case of necessities and luxuries.[22] These results are presented in Column 1 of Table 2. The results confirm the hierarchic demand model. According to the predictions of the model, the impact of inequality on import prices of luxury goods would be higher only if luxuries are only consumed by the rich and necessities by the poor. Luxuries and necessities were defined by the share of income spent on them, and thus based on our classification, rich and poor consume both necessities and luxuries. Thus we do not expect a higher coefficient of the atkinson variable in the case of luxuries, and we cannot reject the hierarchic model. Furthermore, the coefficients of GDP and GDP per capita variables are similar to those using the full sample.

Classifying goods into luxuries and necessities using household budget surveys can only provide very broad classification given data limitations. Household budget surveys usually provide data at aggregate product categories. For example, the Eurostat's Household Budget Survey, which is used in this analysis, uses COICOP classification at level 2. This implies that the most detailed product categories are still very aggregate. For example, at the most disaggregated level, it contains product categories such as food products, or clothing products, which are the finest aggregations we can obtain to define products being luxuries or necessities. Based on Eurostat's Household Budget Surveys using the same methodology as Dalgin, Mitra and

[22] In other words, the 'Atkinson necessity' variable is the atkinson index interacted with a dummy for necessity products; while the 'Atkinson luxury' variable was constructed by interacting the atkinson index with a dummy for luxuries.)

Trindade (2008), for example, food products are necessities, while clothing products are luxuries. This might lead to classifying luxury products, such as sparkling wine, or truffles, into necessities. In order to test the robustness of our results, we "handpicked" roughly 40 products which are most likely luxuries (these include for example silk, fur clothing products, sparkling wine, truffles, caviar, lobsters, certain jewelry products, etc.) [23] As a robustness check we restrict luxuries to only these product categories. The results are presented in Column 2 of Table 2. These results confirm the previous findings. The coefficients of the atkinson variable are not different for luxuries and necessities (we tested this with a t-test and found that the coefficients are not significantly different). Thus these results also provide support for the hierarchic demand model.

5 Summary and Conclusions

In this paper we have examined three theories that help to explain the empirical finding that trade prices (unit values) rise in income per capita in the importing country. We also derived the effect of income inequality on trade prices in each of the three theories. The theoretical predictions were compared with the effect of inequality on import unit values in the data. We find strong empirical support for the theoretical predictions on income levels. An increase in importer income per capita by 1% raises importer unit values by 1.06%. Measuring income inequality with the Atkinson index, we find that unit values of trade decline in income inequality of the importer country. This negative effect is consistent with hierarchic demand, but inconsistent with quality expansion and ideal variety frameworks.

Our results raise a number of issues beyond the scope of this paper. One is the welfare implications of the finding that price differences across markets are driven partly by differences in markups. Do varying markups across markets raise welfare, because they lead to more resources to develop varieties or do they generate excessive distortionary market power? The theoretical structure presented in the paper offers a framework to address this question. The answer to this question also has implications for the welfare effects of the regulation of parallel imports. In addition, the hierarchic demand system could be used to study the effect of higher world income

[23] A list of these goods is provided in the Annex A.2.

per capita and a larger world economy on the worldwide availability of different varieties and the pricing of those different varieties.[24]

References

Alessandria, G. and J. Kaboski (2011). "Pricing-to-Market and the Failure of Absolute PPP." *American Economic Journal: Macroeconomics* forthcoming.

Baldwin, R. and J. Harrigan (2011), "Zeros, Quality and Space: Trade Theory and Trade Evidence," *American Economic Journal: Microeconomics* 3(2): 60-88.

Blackorby, C., D. Primont and R.R. Russell (1998). "Separability: A Survey." in the *Handbook of Utility Theory* Volume I, edited by Salvador Barberá, Peter J. Hammond, Christian Seidl, Norwell, Mass.: Kluwer Academic Publishers. 49-121.

Bennato, A.R. and T. Valletti (2011). 'Pharmaceutical Innovation and Parallel Trade.' Discussion paper presented at the Twelfth CEPR/JIE Conference on Applied Industrial Organization (Tel Aviv).

Bugamelli, M. and T. Roberto (2008). 'Pricing-to-Market and Market Structure.' *Oxford Bulletin of Economics and Statistics* 70(2): 155-180.

Choi, Y.C., D. Hummels and X. Chong (2009). "Explaining Import Quality: The Role of the Income Distribution." *Journal of International Economics* 77(2): 265-275.

Dalgin, M., V. Trindade and D. Mitra (2008). "Inequality, Nonhomothetic Preferences, and Trade: A Gravity Approach." *Southern Economic Association* 74(3): 747-774.

Fajgelbaum, Grossman and Helpman (2009). "Income Distribution, Product Quality, and International Trade." Mimeo Princeton University.

Flam, H. and E. Helpman (1987). "Vertical Product Differentiation and North-South Trade." *American Economic Review* 77(5): 810-822.

[24] See also Saure (2009) and Simonovska (2010)

Francois, J.F. and S. Kaplan (1996). "Aggregate Demand Shifts, Income Distribution, and the Linder Hypothesis." *The Review of Economics and Statistics* 78(2): 244-250.

Francois,J.F: and D. Nelson(2002). "A Geometry of Specialization," *Economic Journal* (July): 649-678.

Francois,J. O. Pindyuk, J. Poeschl, R. Stehrer (2010). "WIOD Data on Trade in Goods: Data Issues and Patterns of Trade in Intermediates." paper presented at the World Input Output Database (WIOD) Conference, Vienna.

Goldberg, P.K. and M.M. Knetter (1997). "Goods Prices and Exchange Rates: What Have We Learned." *Journal of Economic Literature 35(September): 1243-1272.*

Goldberg, P. K. and Verboven, F. (2001). 'The Evolution of Price Dispersion in the European Car Market.' *Review of Economic Studies* 68(4): 811-48.

Goldberg, P. K. and Verboven, F. (2005). 'Market integration and convergence to the Law of One Price: evidence from the European car market.' *Journal of International Economics* 65(1): 49-73.

A. R. Ghosh and Holger C. Wolf (1994). 'Pricing in International Markets: Lessons From The Economist.' NBER Working Paper 4806.

Grossman, G. M. and Lai, E. L.-C. (2008). 'Parallel imports and price controls.' *The RAND Journal of Economics* 39: 378–402.

Guimaraes,P. and P. Portugal (2009). "A Simple Feasible Alternative Procedure to Estimate Models with High-Dimensional Fixed Effects," IZA Discussion Paper 3925.

Hallak, J.C. (2006). "Product Quality and The Direction of Trade." *Journal of International Economics* 68: 238-265.

Haskel, Jonathan and Wolf, Holger (2001). 'The Law of One Price–A Case Study.' *Scandinavian Journal of Economics* 103(4): 545-58.

Helpman, E., M. Melitz and Y. Rubinstein (2008). "Estimating Trade Flows: Trading Opartners and Trading Volumes." *Quarterly Journal of Economics* 123(2): 441-487.

Hsieh, C-T. and P. J. Klenow (2007). "Relative Prices and Relative Prosperity," *American Economic Review* 97(3): 562-585.

Hummels, D., V. Lugovskyy (2009). "International Pricing in a Generalized Model of Ideal Variety." *Journal of Money, Credit and Banking* 41(1): 3-33.

Jackson, Laurence Fraser(1982). "Hierarchic Demand and The Engel Curve for Variety," *The Review of Economics and Statistics* : 8-15.

Helpman, E. and P. Krugman (1985). *Market Structure and Foreign Trade.* Cambridge MA/London: MIT Press.

Kelvin Lancaster (1979). *Variety, Equity and Efficiency.* New York: Columbia University Press.

Lipsey, R. E. and B. Swedenborg (1999). "Wage Dispersion and Country Price Levels." NBER Working Paper 6039.

Lipsey, R. E. and B. Swedenborg (2007). "Explaining Product Price Differences across Countries." NBER Working Paper 13239.

Markusen, James R. (2010). "Putting Per-Capita Income Back into Trade Theory." CEPR Discussion Paper 7790.

Maskus, K. and Y. Chen (2004). 'Vertical price control and parallel imports: Theory and evidence.' *Review of International Economics* 12(4): 551–70.

Melitz, Marc J. (2003). "The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity." *Econometrica* 71(6): 1695-1725.

Pham, Cong S. (2008). "Product Specialization in International Trade: A Further Investigation." *Journal of International Economics* 75: 214-218.

Saure, Philip (2009). "Bounded Love of Variety and Patterns of Trade." Swiss National Bank Working Papers 2009-10.

Schott, Peter K. (2004). "Across-Product Versus Within-Product Specialization in International Trade," *Quarterly Journal of Economics* 119 (2): 647-678.

Simonovska, Ina (2010). "Income Differences and Prices of Tradables." NBER Working Paper 16233.

Annex Table A.1: Sample countries

Albania	Greece	Norway
Argentina	Guatemala	Nepal
Armenia	Guyana	New Zealand
Austria	Hong Kong, China	Pakistan
Azerbaijan	Honduras	Panama
Burundi	Croatia	Peru
Benin	Haiti	Philippines
Burkina Faso	Hungary	Papua New Guinea
Bangladesh	Indonesia	Poland
Bulgaria	India	Portugal
Bosnia and Herzegovina	Ireland	Paraguay
Belarus	Iran, Islamic Rep.	Romania
Belgium-Luxembourg	Israel	Russian Federation
Bolivia	Italy	Rwanda
Brazil	Jamaica	Senegal
Canada	Jordan	Singapore
Switzerland	Kazakhstan	El Salvador
Chile	Kenya	Slovak Republic
China	Kyrgyz Republic	Slovenia
Cote d'Ivoire	Cambodia	Sweden
Cameroon	Korea, Rep.	Thailand
Colombia	Lao PDR	Tajikistan
Costa Rica	Sri Lanka	Turkmenistan
Czech Republic	Lithuania	Tunisia
Germany	Latvia	Turkey
Denmark	Morocco	Tanzania
Dominican Republic	Moldova	Uganda
Ecuador	Madagascar	Ukraine
Egypt, Arab Rep.	Mexico	Uruguay
Spain	Macedonia, FYR	United States
Estonia	Mali	Uzbekistan
Ethiopia	Mongolia	Venezuela
Finland	Mozambique	Vietnam
United Kingdom	Mauritania	Yemen
Ghana	Malawi	Serbia and Montenegro
Georgia	Malaysia	South Africa
Ghana	Nigeria	Zambia
Guinea	Nicaragua	Zimbabwe
Gambia	Netherlands	

Appendix A Classifying goods as final goods, luxuries and necessities

This appendix describes how we classified goods as final goods. Furthermore, it also explains how we grouped the final goods into necessities and luxuries.

Identifying final consumption products required a mapping of HS6 product level data, based on a classification scheme developed for the ongoing update to the EU-KLEMS database, known as the World Input Output Database or WIOD (Francois et al, 2010). This is a large scale, multi-year database construction project funded by the European Commission, Research Directorate General as part of the 7th Framework Programme.[25] While the WIOD mapping starts with a reclassification of the HS6-BEC (UN) mapping at HS6 level, it is somewhat different from the original HS6-BEC scheme. This is because more emphasis is placed under the BEC scheme on whether goods are durables or not, while some products that clearly need processing before final consumption are classified under BEC as consumption goods. For example, televisions are classified as capital goods at HS6 level. Also, meat carcasses are classified as consumption goods at HS6 level under the BEC, though they are in fact bought by industry.

There are further problems due to revisions to the HS classification scheme since the original mapping from BEC to HS was developed. As such, at the end of the day, the mapping we work from WIOD better reflects both the most current HS-combined product lines, and our need for a breakdown of products by use.[26] The result is 1260 HS6 product lines classified as final consumption goods out of a total of 5703 product lines (the remaining products are used for intermediate consumption mostly as inputs into further production or could be used both for intermediate and final consumption).

In order to further distinguish between luxuries and necessities within final goods, the same methodology as in Dalgin, Mitra and Trindade (2008) was used. To do this, first data from Eurostat's Household Budget Surveys were obtained[27]. This dataset provides information on EU member states' households expenditures by five income quintiles at 2-digit COICOP classification. It contains the average expenditure share for each quintile. This allowed the classification of goods into luxuries and necessities based on whether the expenditure shares across the different quintiles were rising or falling. If the expenditure shares were weakly rising, we classified goods as luxuries, if weakly falling, as necessities.[28]

These data were provided in COICOP classification which then had to be mapped into the HS classification in which our trade data were recorded. Given that there is no direct concordance between these two classifications, the HS classified unit value data were mapped first into the

[25] The WIOD consortium includes a number of European research centers and universities, as well as the OECD and UNCTAD.

[26] The full classification scheme can be downloaded from this link: http://www.i4ide.org/people/ francois/data.htm.

[27] Further information about the Eurostat's Household Budget Surveys can be found on Eurostat's website.

[28] We used the expenditure shares provided for the EU aggregate to group products into luxuries and necessities which we then used for the full sample.

Annex Table A.2: Narrow list of luxuries

HS code	Product description	
HS070952	Truffles	Growing of crops; market gardening; horticulture
HS200320	Truffles	Processing and preserving of fruit and vegetables
HS620610	Of silk or silk waste	Manufacture of other wearing apparel and accessories
HS621310	Of silk or silk waste	Manufacture of other wearing apparel and accessories
HS621410	Of silk or silk waste	Manufacture of other wearing apparel and accessories
HS220410	Sparkling wine	Manufacture of beverages
HS870321	Of a cylinder capacity not exceeding 1,000 cc	Manufacture of motor vehicles
HS870322	Of a cylinder capacity exceeding 1,000 cc but not exceeding 1,500 cc	Manufacture of motor vehicles
HS870323	Of a cylinder capacity exceeding 1,500 cc but not exceeding 3,000 cc	Manufacture of motor vehicles
HS870324	Of a cylinder capacity exceeding 3,000 cc	Manufacture of motor vehicles
HS870331	Of a cylinder capacity not exceeding 1,500 cc	Manufacture of motor vehicles
HS870332	Of a cylinder capacity exceeding 1,500 cc but not exceeding 2,500 cc	Manufacture of motor vehicles
HS870333	Of a cylinder capacity exceeding 2,500 cc	Manufacture of motor vehicles
HS910112	With optoelectronic display only	Manufacture of watches and clocks
HS910119	Other	Manufacture of watches and clocks
HS910121	With automatic winding	Manufacture of watches and clocks
HS910129	Other	Manufacture of watches and clocks
HS910191	Electrically operated	Manufacture of watches and clocks
HS910212	With optoelectronic display only	Manufacture of watches and clocks
HS910219	Other	Manufacture of watches and clocks
HS910221	With automatic winding	Manufacture of watches and clocks
HS910229	Other	Manufacture of watches and clocks
HS910291	Electrically operated	Manufacture of watches and clocks
HS330300	Perfumes and toilet waters.	Manufacture of soap,detergents, perfumes and toilet preparations
HS650692	Of furskin	Manufacture of other wearing apparel and accessories
HS420221	With outer surface of leather, of composition leather or of patent leather	Manufacture of luggage, handbags and the like, saddlery and harness
HS711419	Of other precious metal, whether or not plated or clad with precious metal	Manufacture of jewellery and related articles 36.21Stri
HS711620	Of precious or semiprecious stones (natural, synthetic or reconstructed)	Manufacture of jewellery and related articles 36.21Stri
HS950691	Articles and equipment for general physical exercise, gymnastics or athletics	Manufacture of sports goods
HS900410	Sunglasses	Manufacture of optical instruments and photographic equipment
HS900651	With SLR, for roll film of a width not exceeding 35 mm	Manufacture of optical instruments and photographic equipment
HS900652	Other, for roll film of a width less than 35 mm	Manufacture of optical instruments and photographic equipment
HS900653	Other, for roll film of a width of 35 mm	Manufacture of optical instruments and photographic equipment
HS900659	Other	Manufacture of optical instruments and photographic equipment
HS160430	Caviar and caviar substitutes	Processing and preserving of fish and fish products
HS030622	Lobsters (Homarus spp.)	Fishing
HS711711	Cufflinks and studs	Miscellaneous manufacturing n.e.c.
HS710391	Rubies, sapphires and emeralds	Manufacture of jewellery and related articles 36.21Stri
HS621510	Of silk or silk waste	Manufacture of other wearing apparel and accessories
HS621290	Other	Manufacture of other wearing apparel and accessories
HS611520	Women's fulllength or kneelength hosiery, measuring per single yarn less than 67 decitex	Manufacture of knitted and crocheted articles
HS220820	Spirits obtained by distilling grape wine or grape marc	Manufacture of beverages
HS230910	Dog or cat food, put up for retail sale	Manufacture of prepared animal feeds

CPCv.1.0 classification, and then this was mapped into the COICOP classification in which the expenditure shares on different goods were provided.

Appendix B Hierarchic Demand Model

Appendix B.1 Basics

Maximize utility in (13) s.t. the budget constraint $\int_{j\in I} p_j q_j dj = i$ using Kuhn-Tucker. This generates the following (rewritten) first order conditions:[29]

$$q_j\left(\frac{1}{q_j+\gamma_j}-\lambda p_j\right)=0;\ j\in I \tag{B.1}$$

$$\left.\begin{array}{c}\frac{1}{q_j+\gamma_j}=\lambda p_j\\ q_j\geq 0\end{array}\right\} j\in\widetilde{J} \tag{B.2}$$

$$\left.\begin{array}{c}\frac{1}{\gamma_j}<\lambda p_j\\ q_j=0\end{array}\right\} j\in K \tag{B.3}$$

$\widetilde{J}$ is the set of goods that are consumed in positive amounts with a corresponding mass J of goods in the set, K is the set of goods that are not consumed. The set of goods $\widetilde{J}$ consumed in positive amounts is determined by the following condition:

$$j\in\widetilde{J} \text{ if } \exists p_j \text{ s.t. } 1/\gamma_j>\lambda p_j \text{ and } \pi_j\left(p_j,n_j=1\right)\geq 0 \tag{B.4}$$

With $\pi_j\left(p_j,n_j=1\right)$ the profit of a monopolist in sector j with a price of p_j. Hence, the condition for a good to be in the consumption set is that there is a price p_j such that the marginal utility of the good at a consumption level of 0 is larger than this price and that with this price a monopolist can make positive profit.

Rearranging equation (B.2) and substituting back into the budget constraint generates an expression for λ:

$$\lambda=\frac{J}{i+\int_0^J \gamma_j p_j p_j} \tag{B.5}$$

Substituting equation (B.5) into equation (B.2), gives the expression for demand q_j, equation (15) in the main text.

Equation (17)

To calculate the price elasticity facing firm s in sector j, we rewrite demand facing firm i in sector j substituting $E_j=p_j q_j$:

$$q_{sj}=\frac{p_j^\sigma}{p_{sj}^\sigma}q_j$$

[29] More extensive derivations of several of the equations presented in this appendix are available upon request.

Log differentiating this equation we get:

$$\widehat{q_{sj}} = \sigma\left(\widehat{p_j} - \widehat{p_{sj}}\right) + \varepsilon_j \widehat{p_j} \tag{B.6}$$

Using the expression for the price index p_j in equation (14) we get for $\widehat{p_j}$:

$$\widehat{p_j} = \frac{p_{sj}^{1-\sigma}}{\sum_{s=1}^{n_j} p_{sj}^{1-\sigma}} \widehat{p_{sj}} = \frac{1}{n_j} \widehat{p_{sj}} \tag{B.7}$$

Substituting back in into equation (B.6) gives equation (17) in the main text.

Equation (18)

We start by log differentiating ε_{sj} with respect to ε_j from equation (17):

$$\widehat{\varepsilon_{sj}} = \frac{\varepsilon_j}{n_j \varepsilon_{sj}} \widehat{\varepsilon_j} \tag{B.8}$$

Next log differentiate the price index ε_j with respect to demand q_j:

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j} \widehat{q_j} \tag{B.9}$$

Log differentiating q_j with respect to income i and price p_j gives:

$$\widehat{q_j} = -\varepsilon_j \widehat{p_j} + \eta_{q_j,i} \widehat{i} \tag{B.10}$$

Log differentiating the markup pricing rule, we get:

$$\widehat{p_{sj}} = -\frac{1}{\varepsilon_{sj} - 1} \widehat{\varepsilon_{sj}} \tag{B.11}$$

Combining equations (B.7)-(B.11) gives:

$$\widehat{\varepsilon_{sj}} = -\frac{n_j \left(\varepsilon_{sj} - 1\right)\left(\varepsilon_j - 1\right)}{n_j^2 \varepsilon_{sj}\left(\varepsilon_{sj} - 1\right) + \varepsilon_j \left(\varepsilon_j - 1\right)} \eta_{q_j,i} \widehat{i} \tag{B.12}$$

The effect of a higher income i on demand for good j, q_j, through a change in the mass of goods consumed J

We calculate the effect of income i on q_j through a change in the consumption set. Differen-

tiating demand q_j in equation (15) with respect to J gives:

$$\begin{aligned} dq_j &= -\frac{1}{J^2}\left(i + \int_0^J \gamma_j p_j dj\right)\frac{1}{p_j}dJ + \frac{1}{J}\gamma_J p_J \frac{1}{p_j}dJ \\ &= -\frac{1}{J}\frac{1}{p_j}\left(\frac{1}{J}\left(i + \int_0^J \gamma_j p_j dj\right) - \gamma_J p_J\right)dJ \end{aligned}$$

From equation (B.2) we have $\gamma_J p_J = 1/\lambda$, as the demand for the last good consumed is zero, i.e. $q_J = 0$. Substituting as well equation (B.5), we get:

$$dq_j = -\frac{1}{J}\frac{1}{p_j}\left(\frac{1}{\lambda} - \frac{1}{\lambda}\right)dJ = 0 \tag{B.13}$$

Hence, the change in demand q_j through a change in the budget set is zero, in contrast to what Jackson (1982) claims. Still, q_j does move in the same direction as J, as an increase in income i increases both q_j and J as we will show now.

Mass of varieties J rising in income i

We can see that J rises in i by combining $\gamma_J p_J = 1/\lambda$ with equation (B.5). This generates:

$$\frac{1}{J}\left(i + \int_0^J \gamma_j p_j dj\right) = \gamma_J p_J$$

Differentiating this with respect to J and i, using the result in equation (B.13) that the LHS does not vary with J we get:

$$\frac{1}{J}di = \frac{\partial \gamma_J p_J}{\partial J}dJ \tag{B.14}$$

$\gamma_J p_J$ is equal to:

$$\begin{aligned} \gamma_J \frac{\varepsilon_J}{\varepsilon_J - 1}a_J &= \gamma_J \frac{1 + \frac{\gamma_J}{q_J}}{\gamma_J/q_J}a_J = \gamma_J \frac{q_J + \gamma_J}{\gamma_J}a_J \\ &= \gamma_J a_J \end{aligned}$$

We have used once more that $q_J = 0$. As $\frac{\partial \gamma_J a_J}{\partial J} > 0$ by assumption, we find that J is strictly increasing in i.

Strict concavity of the function $f(i_g)$ in equation (30)

Differentiating $f(i_g)$ in equation (30) with respect to income gives:

$$\frac{\partial f(i_g)}{\partial i_g} = \frac{1}{J_g}$$

We have used that the change in J_g does not effect $f(i_g)$, as proved in equation (B.13).

The second derivative of $f(i_g)$ is given by:

$$\frac{\partial^2 f(i_g)}{\partial i_g^2} = -\frac{1}{J_g^2}\frac{\partial J_g}{\partial i_g}$$

In equation (B.14) we have shown that J_g strictly increases in i_g. Therefore, the second derivative is strictly negative.

Equation (23)

To derive equation (23), we start from the following supply equation, demand equation and an equation for the price elasticity in the three unknowns, χ_j, p_j and ε_{sj}.

$$p_j = a_{sj}\frac{\varepsilon_{sj}}{\varepsilon_{sj}-1}\left(\frac{\varepsilon_{sj}f_{sj}}{\chi_j i}\right)^{\frac{1}{\sigma-1}} \tag{B.15}$$

$$\chi_j i = \frac{1}{J}\left(i + \int_0^J \gamma_m p_m dm\right) - \gamma_j p_j \tag{B.16}$$

$$\varepsilon_{sj} = \sigma + \frac{\varepsilon_{sj}f_{sj}}{\chi_j i L}\left(1 + \frac{\gamma_j p_j}{\chi_j i} - \sigma\right) \tag{B.17}$$

Log differentiating (B.15) with respect to χ_j, p_j and ε_{sj} gives us:

$$\widehat{\chi_j} = \frac{\varepsilon_j - \sigma}{n_j(\varepsilon_{sj}-1)}\widehat{\varepsilon_{sj}} - (\sigma-1)\widehat{p_j} - \widehat{i} \tag{B.18}$$

Log differentiating (B.16) generates:

$$\widehat{\chi_j} = -(\varepsilon_j - 1)\widehat{p_j} + (\eta - 1)\widehat{i} \tag{B.19}$$

And finally log differentiating (B.17) leads after some rearranging:

$$\widehat{\varepsilon_{sj}} = \frac{\sigma + 1 - 2\varepsilon_j}{n_j\sigma}\widehat{\chi_j} + \frac{\sigma + 1 - 2\varepsilon_j}{n_j\sigma}\widehat{i} + \frac{\varepsilon_j - 1}{n_j\sigma}\widehat{p_j} \tag{B.20}$$

Merging equations (B.18) and (B.19) gives us an expression for $\widehat{p_j}$:

$$\widehat{p_j} = -\frac{1}{n_j(\varepsilon_{sj}-1)}\widehat{\varepsilon_{sj}} - \frac{\eta}{\sigma - \varepsilon_j}\widehat{i} \tag{B.21}$$

Solving from the same equations (B.18) and (B.19) for $\widehat{\chi_j}$ generates:

$$\widehat{\chi_j} = \frac{(\varepsilon_j - 1)}{n_j(\varepsilon_{sj}-1)}\widehat{\varepsilon_{sj}} + \left(\frac{\eta(\sigma-1)}{\sigma - \varepsilon_j} - 1\right)\widehat{i} \tag{B.22}$$

Substituting equations (B.21) and (B.22) into (B.20) and rewriting gives us:

$$\widehat{\varepsilon_{sj}} = \frac{n_j\left(\varepsilon_{sj}-1\right)}{\left(n_j^2\sigma\left(\sigma-1\right)+\left(n_j-1\right)\sigma\varepsilon_j-\sigma\left(n_j\sigma-1\right)+2\varepsilon_j\left(\varepsilon_j-1\right)\right)}\left(\sigma-\varepsilon_j-\frac{\varepsilon_j\left(\varepsilon_j-1\right)}{\left(\sigma-\varepsilon_j\right)}\right)\widehat{\eta i} \tag{B.23}$$

Sign B_j in equation (23)

From equation (16) $\varepsilon_j > 1$ and we assumed $\sigma > 1$. B_j is positive if numerator and denominator have the same sign. The numerator is positive if:

$$\sigma\left(\sigma-\varepsilon_j\left(2-\frac{1}{\sigma}\right)\right) > 0$$

$$\sigma > \varepsilon_j\frac{2\sigma-1}{\sigma} \tag{B.24}$$

$$\frac{\sigma^2}{2\sigma-1} > \varepsilon_j \tag{B.25}$$

As $\sigma > 1$, equation (B.25) implies $\sigma > \varepsilon_j$, so both numerator and denominator are positive when this condition is satisfied.

The denominator is negative if $\sigma < \varepsilon_j$ and given that $\sigma > 1$, equation (B.24) implies that the numerator is also negative.

The case of a negative numerator and a positive denominator occurs, when the following inequalities are satisfied:

$$\frac{\sigma^2}{2\sigma-1} < \varepsilon_j < \sigma$$

Hence, we have:

$$B_j < 0 \iff \frac{\sigma^2}{2\sigma-1} < \varepsilon_j < \sigma \tag{B.26}$$

Otherwise, we have $B_j < 0$.

Appendix B.2 Income Inequality

Equation (32)

Log differentiating equation (28), we get:

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j-1}{\varepsilon_j}\widehat{q_j} \tag{B.27}$$

As a next step, we log differentiate the expression for q_j in equation (29) with respect to $\sum_{g=1}^{G} f\left(i_g\right)$ with p_j treated as an endogenous variable:

$$\widehat{q_j} = -\varepsilon_j\widehat{p_j} + \frac{q_j+\gamma_j}{q_j}\widehat{\sum_{g=1}^{G} f\left(i_g\right)} \tag{B.28}$$

Substituting equation (B.27) into equation (B.28), we get equation (*32*).

Equation (33)

Equation (33) can be derived by starting from equation (32):

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j}\left(-\varepsilon_j \widehat{p_j} + \frac{q_j + \gamma_j}{q_j}\widehat{\sum_{g=1}^{G} f\left(i_g\right)}\right) \tag{B.29}$$

Combining equation (B.29) with (B.7), (B.8), (B.9), (B.11) gives us:

$$\widehat{\varepsilon_{sj}} = \frac{\varepsilon_j}{n_j \varepsilon_{sj}}\left(-\frac{\varepsilon_j - 1}{\varepsilon_j}\left(-\varepsilon_j \widehat{p_j} + \frac{q_j + \gamma_j}{q_j}\widehat{\sum_{g=1}^{G} f\left(i_g\right)}\right)\right)$$

Going through the same steps as to derive (B.12), we arrive at:

$$\widehat{\varepsilon_{sj}} = -\frac{n_j\left(\varepsilon_{sj} - 1\right)\left(\varepsilon_j - 1\right)}{n_j^2 \varepsilon_{sj}\left(\varepsilon_{sj} - 1\right) + \varepsilon_j\left(\varepsilon_j - 1\right)}\frac{q_j + \gamma_j}{q_j}\widehat{\sum_{g=1}^{G} f\left(i_g\right)}$$

Equation (34)

To derive equation (*34*), we start from the following supply equation, demand equation and an equation for the price elasticity in the three unknowns, χ_j, p_j and ε_{sj} analogous to the case without income inequality.

$$p_j = a_{sj}\frac{\varepsilon_{sj}}{\varepsilon_{sj} - 1}\left(\frac{\varepsilon_{sj} f_{sj}}{\chi_j G\bar{i}}\right)^{\frac{1}{\sigma - 1}} \tag{B.30}$$

$$\chi_j G\bar{i} = \sum_{g=1}^{G} f\left(i_g\right) - \gamma_j p_j \tag{B.31}$$

$$\begin{aligned}\varepsilon_{sj} &= \sigma + \frac{\varepsilon_j - \sigma}{n_j} \\ &= \sigma + \frac{\varepsilon_{sj} f_{sj}}{\chi_j i L}\left(1 + \frac{\gamma_j p_j}{\chi_j G\bar{i}} - \sigma\right)\end{aligned} \tag{B.32}$$

Log differentiating (B.30) with respect to χ_j, p_j, ε_{sj} and $\sum_{g=1}^{G} f\left(i_g\right)$ gives us:[30]

$$\widehat{\chi_j} = \frac{\varepsilon_j - \sigma}{n_j\left(\varepsilon_{sj} - 1\right)}\widehat{\varepsilon_{sj}} - \left(\sigma - 1\right)\widehat{p_j} \tag{B.33}$$

Log differentiating (B.31) gives:

$$\widehat{\chi_j} = -\left(\varepsilon_j - 1\right)\widehat{p_j} + \frac{q_j + \gamma_j}{q_j}\widehat{\sum_{g=1}^{G} f\left(i_g\right)} \tag{B.34}$$

[30] We keep average income constant in this exercise.

And log differentiating (B.32) leads to:

$$\widehat{\varepsilon_{sj}} = \frac{\sigma + 1 - 2\varepsilon_j}{n_j \sigma} \widehat{\chi_j} + \frac{\varepsilon_j - 1}{n_j \sigma} \widehat{p_j} \tag{B.35}$$

Merging equations (B.33) and (B.34) gives us an expression for $\widehat{p_j}$:

$$\widehat{p_j} = -\frac{1}{n_j (\varepsilon_{sj} - 1)} \widehat{\varepsilon_{sj}} - \frac{1}{\sigma - \varepsilon_j} \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f(i_g)} \tag{B.36}$$

Solving from the same equations for $\widehat{\chi_j}$ generates:

$$\widehat{\chi_j} = \frac{(\varepsilon_j - 1)}{n_j (\varepsilon_{sj} - 1)} \widehat{\varepsilon_{sj}} + \frac{\sigma - 1}{\sigma - \varepsilon_j} \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f(i_g)} \tag{B.37}$$

Substituting equations (B.36) and (B.37) into (B.35) gives us after rewriting:

$$\begin{aligned} \widehat{\varepsilon_{sj}} = & \frac{n_j (\varepsilon_{sj} - 1)}{\left(n_j^2 \sigma (\sigma - 1) + (n_j - 1) \sigma \varepsilon_j - \sigma (n_j \sigma - 1) + 2\varepsilon_j (\varepsilon_j - 1)\right)} \\ & * \left(\sigma - \varepsilon_j - \frac{\varepsilon_j (\varepsilon_j - 1)}{(\sigma - \varepsilon_j)}\right) \frac{q_j + \gamma_j}{q_j} \widehat{\sum_{g=1}^{G} f(i_g)} \end{aligned} \tag{B.38}$$

Equation (36)

To get to equation (36), we start from equation (35) and log differentiate with respect to p_j and i_H taking the relation between the changes in i_L and i_H into account:

$$\widehat{\varepsilon_j} = -\frac{\varepsilon_j - 1}{\varepsilon_j} \left(-\varepsilon_j \widehat{p_j} + \frac{q_{j,H} H \eta_{q_{j,H}, i_H} - q_{j,L} L \eta_{q_{j,L}, i_L} \frac{i_H H}{i_L L}}{q_{j,H} H + q_{j,L} L} \widehat{i_H} \right)$$

Going through the same steps as to derive the effect of a change in the Atkinson index, we arrive at:

$$\widehat{\varepsilon_j} = -\frac{n_j (\varepsilon_{sj} - 1)(\varepsilon_j - 1)}{n_j^2 \varepsilon_{sj} (\varepsilon_{sj} - 1) + \varepsilon_j (\varepsilon_j - 1)} H \frac{q_{j,H} \eta_{q_{j,H}, i_H} - q_{j,L} \eta_{q_{j,L}, i_L} \frac{i_H}{i_L}}{q_{j,H} H + q_{j,L} L} \widehat{i_H} \tag{B.39}$$

We rewrite the expression for the income elasticity $\eta_{q_{j,G}, i_G}$ (given in equation (19)) as follows:

$$\eta_{q_{j,g}, i_g} = \frac{\frac{1}{J_g} i_g}{q_{j,g} p_j} \tag{B.40}$$

Substituting equation (B.40) into (B.39) gives us:

$$\widehat{\varepsilon_j} = -\frac{n_j (\varepsilon_{sj} - 1)(\varepsilon_j - 1)}{n_j^2 \varepsilon_{sj} (\varepsilon_{sj} - 1) + \varepsilon_j (\varepsilon_j - 1)} \left(\frac{1}{J_H} - \frac{1}{J_L} \right) \frac{i_H H}{p_j q_j} \widehat{i_H} \tag{B.41}$$